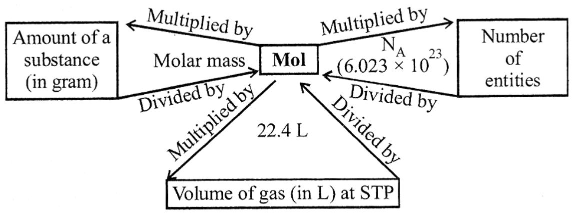
PHYSICAL CHEMISTRY

1. Some Basic Concepts of Chemistry



- Molecular Mass $= \dfrac{\textbf{Average relative mass of one molecule}}{\frac{1}{12} \times \textbf{mass of C} - \textbf{12 atom}}$
- Molecular mass $= 2 \times \text{VD}$
- Eq. wt. of metal $= \dfrac{\text{wt. of metal}}{\text{wt. of } H_2 \text{displaced}} \times 1.008$
- Eq. wt. of metal $= \dfrac{\text{wt. of metal}}{\text{wt. of oxygen combined}} \times 8$

  $= \dfrac{\text{wt. of metal}}{\text{wt. of chlorine combined}} \times 35.5$
- Molecular formula $= (\text{Empirical formula})_n$
- 1 amu $= 1.66 \times 10^{-24}$ g (amu - atomic mass unit)
- $n = \dfrac{w}{M}$

  where w is weight of substance and M is molar mass of substance, n is number of moles
- $n = \dfrac{\text{given particles}}{6.022 \times 10^{23}}$ where n is number of moles
- $n = \dfrac{\text{Given volume}}{22.4 \text{ lit at STP}}$ where n is number of moles
- Average atomic mass

  $= \dfrac{(RA \times At.mass)_1 + (RA \times At.mass)_2}{RA(1) + RA(2)}$

  where RA is relative abundance.

- 1 gram atom = N_A atoms = 6.023×10^{23} atoms = Gram atomic mass
- 1 gram molecule = N_A molecules = 6.023×10^{23} molecules = Gram molecular mass
- Mass % of an element

  $= \dfrac{\text{Mass of that element in the compound} \times 100}{\text{Molar mass of the compound}}$
- The value of n can be obtained by the following relationship

  $n = \dfrac{\text{Molecular mass}}{\text{Empirical formula mass}}$
- Normality (N)

  $= \dfrac{\text{Gram equivalent of the solute}}{\text{Volume of the solution in litre}} = \dfrac{W \times 1000}{GEM \times V \text{ in mL}}$,

  where GEM is gram equivalent mass of solute.
- Equivalent mass of an element $= \dfrac{\text{Atomic mass}}{\text{Valency}}$
- Equivalent mass of an acid $= \dfrac{\text{Molecular mass}}{\text{Basicity}}$
- Equivalent mass of a base $= \dfrac{\text{Molecular mass}}{\text{Acidity}}$
- Equivalent mass of a salt

  $= \dfrac{\text{Formula mass}}{\text{Total +ve or } - \text{ve charge}}$
- Equivalent mass of an oxidising agent

  $= \dfrac{\text{Molecular mass}}{\text{Total change in oxidation number}}$

- Molarity × GMM (solute) = Normality × GEM (solute), where GMM is gram molecular mass.
- Normality and molarity equations :

  $N_1V_1 = N_2V_2$

  $M_1V_1 = M_2V_2$ (For dilution)

  $$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$$

  (For reaction where n_1 and n_2 are no. of moles of the two reactants in a balanced chemical equation)

  $M_3(V_1 + V_2) = M_1V_1 + M_2V_2$

  (Final molarity on mixing two non-reacting solutions)
- Number of millimoles = Molarity × V in mL
- Number of equivalents = Normality × V in L
- Number of milliequivalents

  = Normality × V in mL
- Number of gram atoms or mole of atoms

  $$= \frac{\text{Mass of element in gram}}{\text{Gram atomic mass}}$$
- 1 mole = mass of 6.023×10^{23} particles (atoms/molecules)
- 1 mole atoms = Gram atomic mass (or 1 g atom) = 6.023×10^{23} atoms
- 1 mole molecules = Gram molecular mass (or 1 g molecule) = 6.023×10^{23} molecules

  = 22.4 L at STP
- 1 mole ionic compound = Gram formula mass = 6.023×10^{23} formula units
- No. of gram equivalents

  $$= \frac{\text{Weight of the solute(in g)}}{\text{Equivalent weight of the solute}}$$
- No. of milliequivalents

  $$= \frac{\text{Weight of the solute(in g)}}{\text{Equivalent weight of solute}} \times 1000$$
- Strength of a solution

  $$= \frac{\text{Wt. of the solute (in g)}}{\text{Vol. of solution (in litres)}}$$
- Parts per million (ppm) of substance A (ppm)

  $$= \frac{\text{Mass of A}}{\text{Mass of solution}} \times 10^6 \quad \text{or}$$

  $$= \frac{\text{Vol. of A}}{\text{Vol. of solution}} \times 10^6$$
- Molality (m) = $\dfrac{M}{\rho - \dfrac{MM_2}{1000}}$ or

  Molarity (M) = $\dfrac{m\rho}{\left(1+\dfrac{mM_2}{1000}\right)}$

  where M_2 = molecular mass of solute,

  ρ = density
- $$M = \frac{n_1}{(n_1M_1 + n_2M_2)/\rho}$$

  Here, n_1M_1 = mass of solute,

  n_2M_2 = mass of solvent

  i.e., $n_1M_1 + n_2M_2$ = mass of solution.